

Claims

[c1] What is claimed is:

1. A method for guiding an end effector to a target position within a person, comprising:
generating a plurality of digital images of an interior anatomy of the person when the person has a predetermined respiratory state;
indicating a skin entry position on at least one of the digital images;
indicating the target position on at least one of the digital images;
determining a trajectory path based on the skin entry position and the target position; and
moving the end effector along the trajectory path toward the target position when the person has substantially the predetermined respiratory state.

[c2] 2. The method of claim 1, wherein generating the plurality of digital images comprises:
moving the person within a scanning device along an axis; and,
generating the plurality of cross-sectional digital images during the movement wherein each cross-sectional im-

age is generated at a distinct axial position.

- [c3] 3. The method of claim 1, wherein moving the end effector comprises:
 - monitoring a respiratory state of the person over time;
 - and
 - moving the end effector along the trajectory path when a difference between the monitored respiratory state and the predetermined respiratory state is less than or equal to a threshold value.
- [c4] 4. The method of claim 1, wherein the end effector is moved at a predetermined speed.
- [c5] 5. The method of claim 1, wherein the plurality of digital images comprises a plurality of computerized tomography images.
- [c6] 6. A system for guiding an end effector to a target position within a person, comprising:
 - a respiratory monitoring device for monitoring a respiratory state of the person;
 - a scanning device configured to scan an interior anatomy of the person when the person has a predetermined respiratory state to generate scanning data;
 - a first computer generating a plurality of digital images based on the scanning data;

a second computer configured to display the plurality of digital images, the second computer further configured to allow an operator to indicate a skin entry position on at least one of the digital images, the second computer further configured to allow the operator to indicate the target position on at least one of the digital images, the second computer further configured to determine a trajectory path based on the skin entry position and the target position; and
an end effector insertion device having the end effector adapted to be inserted into the person, the second computer inducing the end effector insertion device to move the end effector along the trajectory path toward the target position when the person has substantially the predetermined respiratory state.

- [c7] 7. The system of claim 6, wherein the respiratory monitoring device comprises an infrared respiratory measurement device that detects a position of a chest of the person.
- [c8] 8. The system of claim 6, wherein the scanning device comprises a computerized tomography scanner and the plurality of digital images comprise a plurality of computerized tomography images.
- [c9] 9. The system of claim 6, wherein the end effector inser-

tion device comprises an end effector driver configured to linearly move the end effector.

- [c10] 10. The system of claim 6, further comprising a positioning device operably coupled to the end effector insertion device for disposing the end effector insertion device at a predetermined position.
- [c11] 11. The system of claim 6, wherein the end effector insertion device can orient the end effector along the trajectory path.
- [c12] 12. The system of claim 6, wherein the second computer is further configured to move the person within the scanning device for generating the plurality of digital images during the movement wherein each digital image is generated at a distinct axial position of the person.
- [c13] 13. The system of claim 6, wherein the person has substantially the predetermined respiratory state when a difference between the monitored respiratory state and the predetermined respiratory state is less than or equal to a threshold value.
- [c14] 14. The system of claim 6, wherein the second computer induces the end effector insertion device to move the end effector along the trajectory path toward the target position at a predetermined speed.

[c15] 15. A system for guiding an end effector to a target position within a person, comprising:
a respiratory monitoring device for monitoring a respiratory state of the person;
a scanning device configured to scan an interior anatomy of the person when the person has a predetermined respiratory state to generate scanning data;
a first computer generating a plurality of digital images based on the scanning data, the first computer further configured to display the plurality of digital images, the first computer further configured to allow an operator to indicate a skin entry position on at least one of the digital images, the first computer further configured to allow the operator to indicate the target position on at least one of the digital images, the first computer further configured to determine a trajectory path based on the skin entry position and the target position; and
an end effector insertion device having the end effector adapted to be inserted into the person, the first computer inducing the end effector insertion device to move the end effector along the trajectory path toward the target position when the person has substantially the predetermined respiratory state.

[c16] 16. An article of manufacture, comprising:
a computer storage medium having a computer program

encoded therein for guiding an end effector to a target position within a person, the computer storage medium including:

code for displaying and generating a plurality of digital images of an interior anatomy of the person when the person has a predetermined respiratory state;

code for indicating a skin entry position on at least one of the digital images;

code for indicating the target position on at least one of the digital images;

code for determining a trajectory path based on the skin entry position and the target position; and

code for moving the end effector along the trajectory path toward the target position when the person has substantially the predetermined respiratory state.

[c17] 17. The article of manufacture of claim 16, wherein the code for displaying the plurality of digital images comprises:

code for scanning a predetermined region of the person along an axis; and,

code for generating the plurality of digital images during the movement wherein each digital image is generated at a distinct axial position.

[c18] 18. The article of manufacture of claim 16, wherein the code for moving the end effector comprises:

code for monitoring a respiratory state of the person over time; and

code for moving the end effector along the trajectory path when a difference between the monitored respiratory state and the predetermined respiratory state is less than or equal to a threshold value.

- [c19] 19. The article of manufacture of claim 16, wherein the computer storage medium further includes code for moving the end effector at a predetermined speed into the person.
- [c20] 20. The article of manufacture of claim 16, wherein the plurality of digital images comprises a plurality of computerized tomography images.
- [c21] 21. A method for guiding an end effector to a target position within a person, comprising:
 - monitoring a respiratory state of a person during at least one respiratory cycle; and
 - moving an end effector along a trajectory path toward the target position in the person when the person has substantially a predetermined respiratory state.